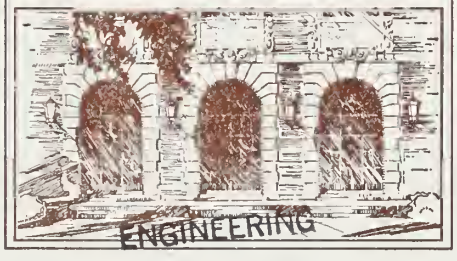

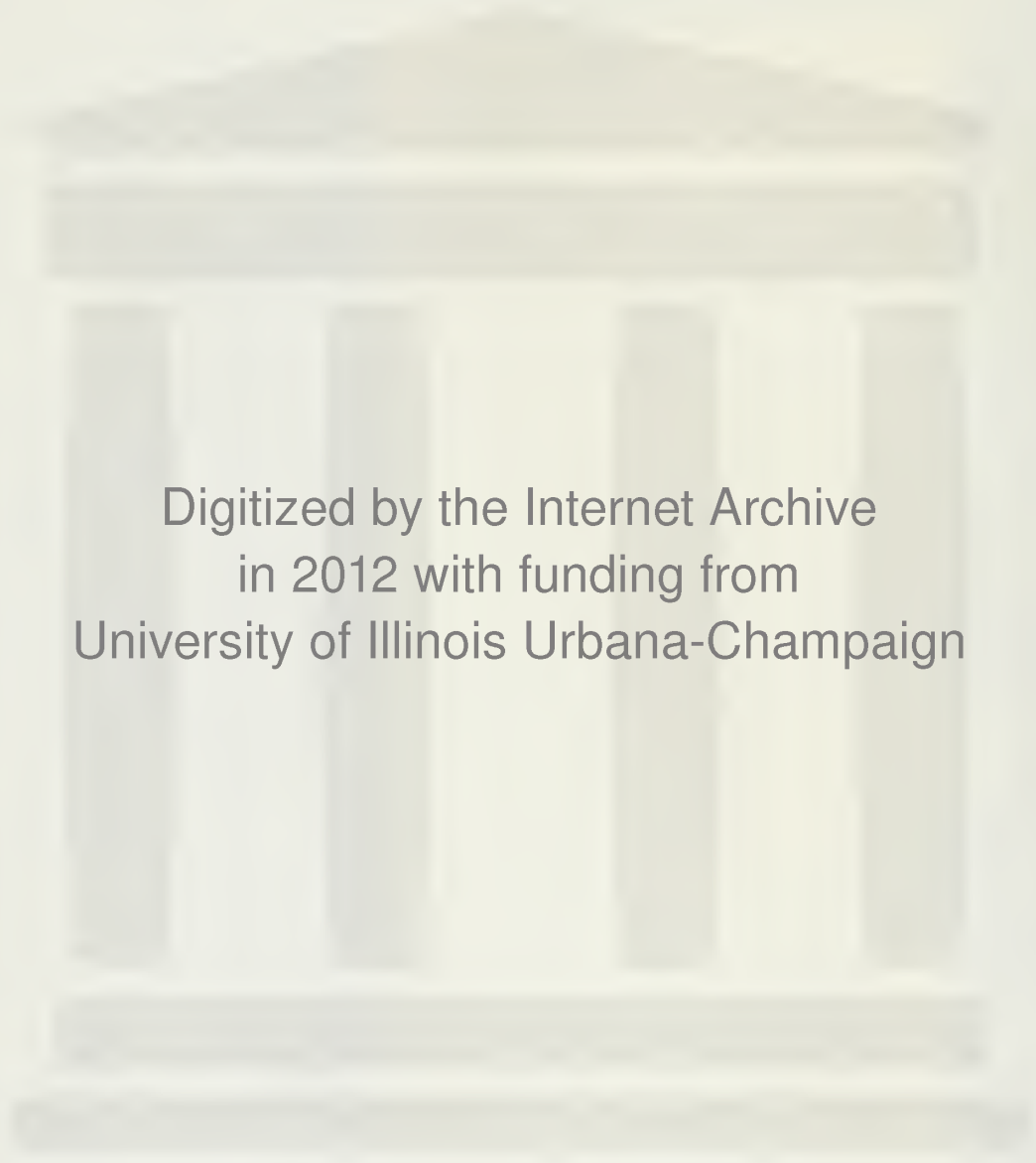

Center for Advanced Computation
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
URBANA, ILLINOIS 61801

CAC Document No. 126

U.S. AIR POLLUTANT GENERATION IN 1967

By
James Toscas

January 8, 1974

CAC Document No. 126

U. S. AIR POLLUTANT GENERATION IN 1967

By

James Toscas

Center for Advanced Computation
University of Illinois at Urbana-Champaign
Urbana, Illinois 61801

January 8, 1974

This work was supported in part by a grant from the National Science Foundation.

ABSTRACT

In this report, data on 1967 air pollutant generation are assembled from existing data sources, and aggregated to correspond to a 97 sector input-output model under development at the Center for Advanced Computation. Inadequacies and apparent contradictions in existing data are identified, and improvements are recommended for making it acceptable for use with the model.

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

This report presents the results of an effort to assemble available data on 1967 air pollutant generation for use with the 97-sector input-output model of the U.S. economy. The model is being developed at the Center for Advanced Computation (CAC) by aggregating the U.S. Department of Commerce model from 368 sectors. [1] The work was performed during the Spring of 1973, and draws on data sources available at that time.

The basic technique used was to obtain air pollutant emissions data for various SIC (Standard Industrial Classification) sectors. If data did not exist for 1967, it was scaled from data for a nearby year using constant-dollar output ratios. The primary data sources utilized, herein referred to as the "RFF Report" [2] and the "BLS Report" [3], were also developed for use with input-output models. Since the sector definitions and output bases are unique to each model, "pollution coefficients" could not be taken directly from the cited reports. This paper documents the methods used to reconstruct the basic pollutant generation data, and to re-order it to the desired 97 sectors so it could be divided by the appropriate output level.

2. 1967 AIR POLLUTANT GENERATION

The results are presented first, in Tables 1 and 2. The entries in the Tables represent the amount of pollutant, in pounds, for each of the 97 CAC sectors, in the year 1967. Table 3 identifies the CAC sectors in terms of the Standard Industrial Classification.

For some sectors the notation •• appears where a pollutant quantity belongs, and a "transfer number" appears in parentheses next to the CAC sector number. This indicates that the values for several sectors have been combined, and listed opposite the sector indicated by the transfer numbers. A detailed explanation of this technique is contained in section 4.1.

The notation NA indicates that part or all of the data necessary to evaluate that particular element was designated by the source as "not available".

A value of zero does not necessarily mean that no pollution is generated; it may also mean that no data was available and the sector was excluded from study by authors of the source documents. (See Section 4.)

3. SOURCES OF DATA

The "RFF Report" [2] was prepared by International Research and Technology Corporation, for Resources for the Future, Inc., in December, 1970. It utilized an input-output model of the economy to predict the effects of normal technological change and specific pollution abatement activities on the economy and on the environment. Research was done at IR&T on pollution generated in most sectors of the economy, as required by the model. The resulting data on pollution generation is utilized in this report.

The "BLS Report" [5] was prepared for the Bureau of Labor Statistics by IR&T in September, 1972. Research was done to determine base year and projected pollution levels, and an input-output approach was used to determine the costs of abatement of this pollution at several selected efficiencies. The base year(1970) pollution results were used as the starting point for deriving the 1967 figures in this report.

4. METHOD OF ANALYSIS

The specific procedure used for each group of results is given below in the section dealing with that group. In all groups sector reorganization, described immediately below, was required.

4.1 Sector Reorganization

The RFF and BLS studies utilize sectoring schemes that are somewhat different from the CAC scheme, hence it was necessary to reorganize the sectors.

The SIC, Standard Industrial Classification,which make up each RFF and BLS sector are given in Tables 4 and 5. These were compared to the SIC contents of the CAC sectors, yielding one of the following four conditions:

A. The contents were identical.

B. The contents differed, with the contents of the RFF sector being the equivalent of the contents of two or more CAC sectors .

C. The contents differed, with the contents of two or more RFF sectors being the equivalent of the contents of one CAC sector.

D. The contents were approximately equivalent, i.e., they were identical except for one or two subgroups of either, which subgroups could be found in one sector, but were missing from the other.

The respective courses of action taken were:

A. The sectors were corresponded identically.

B. The RFF sector was corresponded to the first of the appropriate CAC sectors. This CAC sector number was then used as a "transfer number" in listings of the subsequent CAC sectors.

C. The values for the appropriate RFF sectors were summed, and the results assigned to the CAC sector.

D. The discrepant subgroups were checked as to relative importance in the sector. In all cases, they were found to have reasonable small importance (judged by relative output), and little error was introduced by corresponding the sectors identically.

For example, with the RFF report, two such cases arose. For the sector designated "Apparel and Related Products" in the RFF report, with SIC content 23, the sectors corresponded to it were CAC 18, "Apparel", with SIC content 225,23(ex.239), and 3992, and CAC 19, "Miscellaneous Fabricated Textile Products" with SIC content 239.

The discrepancies in SIC contents lie in the "hosiery", "knit apparel mills", and "knit fabric mills", subgoups, which RFF puts in the sector " Textile Mill Products", SIC content 22 and which account for about 19% of the 1967 dollar output of that sector. When put in with the "Apparel and Related Products" sector, these subgoups account for about 17% of the sector's 1967 dollar output. The above percentages were derived from another data source [6], and could not rightly be used to reconstruct the sectors properly; they serve only as an indication of the error introduced in ignoring the discrepancy and corresponding the sectors identically.

4.2 RFF Sector Outputs, '63, '67 (Table 5)

These values were taken directly from the RFF Report [2a] and the sectors reorganized into CAC sectors. Units : 1967 dollars.

4.3 RFF Heat & Power Generation Pollutants (Table 1a)

These sets of 5 values for each sector (one for each of the 5 major air pollutants were taken from the RFF Report [2b], where they appeared for the year 1963, and linearly extrapolated to the year 1967 by multiplying by the factor $[\frac{1967 \text{ output}}{1963 \text{ output}}]$, where the outputs are those described in Section 4.2. The use of a linear extrapolation assumes that the air pollution generated by a sector is directly proportional to its dollar output, which is reasonable for small excursions about a given point, and that the coefficient of proportionality does not change appreciably in time. The sectors were then reorganized into CAC sectors. Units: pounds pollutant in the year 1967.

4.4 RFF Process Pollutants (Table 1b)

These sets of 5 values for each sector (one for each of the 5 major air pollutants were taken directly from the RFF Report [2c], and the sectors reorganized into CAC sectors. Units: pounds pollutant in the year 1967.

4.5 RFF Total Pollutants (Table 1c)

These values, for a given sector, are the sumes of the respective RFF heat and power generation pollutants and the RFF process pollutants.

4.6 BLS Heat and Power Generation Pollutants (Table 2a)

These values were calculated from the data in [3] as follows. For each sector:

The source gives total BTU fuel burned and fractions therof for

the 4 major fuels (coal, residual oil, natural gas, distillate oil) in the year 1967.

(1) Fractions multiplied by total Btu give energy used (Btu) for each fuel.

(2) Energies (Btu) converted [4] to physical quantities (tons, bbl, cu. ft., bbl).

(3) Quantities (tons, bbl, cu. ft.,bbl) multiplied by EPA emission factors, as given in BLS Report [5a] yield pounds of each of the 5 major air pollutants, for each fuel.

(4) Pounds pollutants for the 4 fuels summed, by type of pollution, give total pounds of pollution by type in 1967. In [3], many of the values for individual fuel use were not given and were designated as "not available". In such cases, no heat and power pollutants were calculated.

The sectors were reorganized into CAC sectors. Any "not available" data is designated with "NA" on the printout. Units: pounds pollutant in the year 1967.

4.7 BLS Process Pollutants (Table 2b)

These sets of 5 values for each sector (one for each of the 5 major air pollutants) were calculated using two pieces of source material as follows.

Directly from the BLS Report [5b] came process pollutant coefficients in tons per million 1963 dollars of sector output. The output bases, in 1963 dollars, used to calculate these coefficients were obtained from Gutmanis [6]. These were outputs for the years 1966-1970. The 1967 outputs were multiplied by the respective BLS pollution coefficients (derived for the year 1970) to yeild total process pollutants in 1967, assuming, as in Section 4.3, that the air pollution generated by a sector is directly proportional to its dollar output, for small excursions about a given value, and , in addition, that the coefficient of proportionality does not vary appreciably with time. The results were converted from tons to pounds and the sectorsreorganized into CAC sectors. Units: pounds pollutant in the year 1967.

4.8 BLS Total Pollutants (Table 2c)

These values, for a given sector, are the sums of the respective BLS heat and power generation pollutants and the BLS process pollutants.

5. SECTORS EXCLUDED FROM ANALYSIS

The data sets obtained are not all-inclusive, due to the limited source data available. Many sectors are shown as having zero pollution and/or zero outputs. This means that the sectors either

1) Were not included (N.I.) in the study due to inavailability of data, or

2) Had a negligible (NEG.) contribution to air pollution.

Table 7 indicates sectors excluded for either of the above reasons, in the two major data sources, the RFF Report and the BLS Report.

6. RELIABILITY OF RESULTS

The only gauge to the reliability of the two sets of results obtained is their agreement with each other and their agreement with the results of other studies.

On the second point, no other results are available on a sector-by-sector basis. Only totals over all sectors are available, and the external comparison must be done at this level.

Insofar as mutual agreement goes, it is not expected that the results be identical, because the BLS results represent pollutant generation while the RFF results seem to represent pollutant emission. In the latter case, pollution abatement devices are assumed to be working. The word "seem" is used above because it is not clearly and unambiguously stated anywhere in the report just what numbers are being presented. Further, where one may make inferences based on vague suggestions found in some places, he is contradicted by the numbers themselves: emission values exceeding generation values. The RFF report is not internally consistent, so its results cannot seriously be compared with anything. Nevertheless, they are one of only two sets of data available.

The BLS results are clearly generation results. In comparing them sector by sector with the RFF results, huge discrepancies are found, so much so that it becomes worthwhile to compare only the orders of magnitude of the results. In doing the comparison, patterns are found that are contradictory. For example:

1) Overall, RFF (controlled) values exceed BLS (uncontrolled) values.
2) The greatest degree of agreement occurred for particulates emissions, which, since they are most extensively controlled, should have shown the greatest disagreement.
3) The most consistent disagreements occurred in hydrocarbons and sulfur dioxide emissions, which are controlled to a far lesser extent than particulates. In addition, RFF (controlled) values consistently exceeded BLS (uncontrolled) values for the sulfur dioxide case, while the reverse was consistently true for the hydrocarbons case.

The above patterns appeared only in the heat and power generation pollution figures. No distinct patterns of agreement or disagreement

appeared in the process pollution figures. However, here also the RFF (controlled) results generally exceeded the BLS (uncontrolled) results. To make matters yet more perplexing, the BLS report is more recent than the RFF report, and would perhaps be expected to show more pollution simply on the basis of newly-acquired data.

The sector-by-sector comparison was done only on those sectors which were treated in both reports. When comparing all-sector totals, however, care must be exercised so that the comparison is made between results that pertain to the same areas of the economy.

As an outside control total reference, a report by HEW [7] was utilized. It breaks down the totals into subtotals according to general type of source, e.g., heat and power, process, autos, etc. The numbers given are for controlled emissions, and thus cannot be directly compared to the BLS report data, so they were compared to the RFF report data, which seemed to be controlled emissions also.

10^{10} lbs./year		P	HC	SO_x	CO	NO_x
Heat & Power (Excluding Electric Utilities)	RFF	2.09	0.01	1.69	0.04	0.54
	HEW	0.73	0.34	1.60	1.14	1.41
Process	RFF	2.20	1.28	1.54	5.11	0.22
	HEW	1.68	1.18	1.46	3.46	0.16
Electric Utilities	RFF	0.12	0.00	3.36	0.00	0.80
	HEW	1.12	0.00	3.08	0.00	0.72

The HEW numbers in the above table are arrived at as follows:

For heat and power, the 1967 values for "fuel combustion" (found in Tables 3, 6, 8, 10, and 12 of the HEW report, [7] are multiplied by the fractions of fuel combustion emissions that are not due to electric utilities. These fractions are determined from Table 13 of the HEW report. To the resulting numbers are added the values under "Transportation, other" (from the same tables).

For industrial processes, the values under "industrial processes" and "solid waste disposal" are summed.

For utilities, the values found in Table 13 are used.

The RFF numbers used are the totals found in Tables 1a and 1b of this report, plus the values under "Owner-occupied dwellings", "Rental-occupied dwellings", and "All other space heating" [2b, Table 17] (for space heat) and "Solid waste incineration" [2c] (for processes). For utilities, the values under "Electric utilities" in [2b, Table 17] were used. The comparison of all-sector totals shows many cases of favorable agreement, and some cases of great disagreement (e.g., utilities particulates emissions values differ by a factor of 10). The agreement at this level should not show any such great discrepancies, since previously derived totals should have been used as controls in the finer, sector-by-sector analysis. At least, they should have been acknowledged.

The impression resulting from the above considerations is that the RFF report is an unreliable data source. Poor documentation precludes pinpointing potential sources of error, so that the entire work must bear the lack of confidence.

Given this fact, the BLS report, which disagrees consistently with the RFF report regarding pollution data, can only be said to be an unproven data source. Comparing the BLS all-sector totals with the HEW data should show the BLS numbers (generation) exceeding the HEW numbers (emissions).

10^{10} lbs.		P	HC	SO_x	CO	NO_x
Heat & Power	BLS	.421	.306	.123	.010	.013
	HEW	.734	.340	1.60	1.14	1.41
Process	BLS	.824	.072	.119	1.04	.307
	HEW	1.68	1.18	1.46	3.46	.160

The BLS numbers above are the all-sector totals from Tables 2a and 2b of this report. Some glaring discrepancies arise, especially for process pollution. Looking at Table 2b, one can see that the BLS report is incomplete in its treatment of process polluters. Even in the heat and power generation values, there are huge factors of 100 discrepancies in

the carbon monoxide and nitrous oxides emissions. On the basis of the above comparisons, both the HEW and BLS reports must also be considered unproven data sources. Further research must be performed and carefully documented before any confidence can be placed in pollution data.

Since pollution is a local problem, it is suggested that any further research in this area be accompanied by adequate geographical information.

7. CONCLUSIONS AND RECOMMENDATIONS

As is common in research of this type, the results given in the RFF and BLS reports were doubtless based on methods ranging from precise mathematical reduction of reliable, statistically significant data to rough, order-of-magnitude educated guesses by persons familiar with the processes in question. The problem is that these sources give little indication of the probable error in their results, which varies enormously according to the wide range of methods employed. In addition, documentation of these methods is inadequate, precluding the possibility of establishing our own confidence limits for the results.

A general observation, upon comparing the RFF and BLS numbers (sector by sector), and comparing the RFF,BLS, and HEW grand totals, is that the results command little confidence. The data are useful only if one is willing to label one set as the "best estimate", and accept it as the norm. This situation points out the need for more and better research to obtain consistent and accurate values for the amounts of pollutants generated by the major polluting sectors. In particular, it is recommended that the "BLS Report" data used in this report be extensively supplemented with more detailed and more reliable data, expecially for the electric utilities sector, complete with estimates of potential errors. For completeness, pollutants resulting from energy use in the "final demand" sectors should also be included. The method of transforming such data, once they become available, into a form appropriate for use with the CAC 97-sector input-output model, is essentially established in this report.

It is probably most appropriate to express pollution coefficients for process pollutants in terms of pounds per dollar output. However, heat and power generation pollutants are proportional to energy use, and hence should be expressed in terms of pounds per Btu of the various fuels used. With the present CAC energy model, based on dollar allocations of fuels, little would be gained by using energy-based pollution coefficients. However, the model is currently being modified to allocate energy using physical data rather than dollar output data. Once this modification is complete, the data in this report could be used to calculate the energy-based pollution coefficients. The data in the BLS Report thus provides the best starting point for the development of such coefficients.

TABLE 1a.
Heat and power generation pollutants, 1967,
based on data from Ref. 2

POUNDS PER ANNUM

SECTOR	PARTICULATES	HYDROCARBONS	SULFUR OXIDE	CARBON MONOXIDE	NITROUS OXIDES
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.171224E 09	0.134448E 07	0.151524E 09	0.332206E 07	0.388573E 08
14	0.192094E 10	0.133700E 08	0.119825E 10	0.357839E 08	0.393169E 08
15	0.324374E 08	0.531917E 06	0.446632E 08	0.149521E 07	0.120476E 08
16	0.622741E 09	0.458390E 07	0.428253E 09	0.118065E 08	0.120852E 09
17 (16)	..	..	..	..	..
18	0.350763E 08	0.315553E 06	0.331962E 08	0.718033E 06	0.995006E 07
19 (18)	..	..	..	..	..
20	0.790029E 08	0.870070E 06	0.101268E 09	0.161911E 07	0.313790E 08
21 (20)	..	..	..	..	..
22	0.102983E 09	0.692639E 06	0.692343E 08	0.185673E 07	0.178102E 08
23 (22)	..	..	..	..	..
24	0.338808E 10	0.230913E 08	0.230025E 10	0.626163E 08	0.599957E 09
25 (24)	..	..	..	..	..
26	0.270999E 08	0.291676E 06	0.337104E 08	0.597522E 06	0.126235E 08
27	0.528761E 10	0.331351E 08	0.270322E 10	0.952753E 08	0.927896E 09
28 (27)	..	..	..	..	..
29 (27)	..	..	..	..	..
30 (27)	..	..	..	..	..
31	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0
34	0.561249E 09	0.372061E 07	0.319243E 09	0.102782E 08	0.909038E 08
35	0.771302E 08	0.580445E 06	0.550563E 08	0.147044E 07	0.153060E 08
36 (35)	..	..	..	..	..
37	0.225131E 10	0.144721E 08	0.120037E 10	0.408551E 08	0.445415E 09
38 (37)	..	..	..	..	..
39	0.300522E 10	0.222147E 08	0.209022E 10	0.572127E 08	0.779827E 09
40 (39)	..	..	..	..	..
41	0.259496E 09	0.227446E 07	0.242493E 09	0.527859E 07	0.871115E 08
42 (41)	..	..	..	..	..
43 (41)	..	..	..	..	..
44 (41)	..	..	..	..	..
45	0.554642E 09	0.469761E 07	0.441146E 09	0.120663E 08	0.136390E 09
46 (45)	..	..	..	..	..
47 (45)	..	..	..	..	..
48 (45)	..	..	..	..	..
49 (45)	..	..	..	..	..
50 (45)	..	..	..	..	..
51 (45)	..	..	..	..	..
52 (45)	..	..	..	..	..
53 (45)	..	..	..	..	..
54 (45)	..	..	..	..	..
55	0.329721E 09	0.246698E 07	0.233108E 09	0.630278E 07	0.733342E 08
56 (55)	..	..	..	..	..
57 (55)	..	..	..	..	..
58 (55)	..	..	..	..	..
59 (55)	..	..	..	..	..
60 (55)	..	..	..	..	..
61	0.841375E 09	0.564410E 07	0.489434E 09	0.154778E 08	0.144710E 09
62 (61)	..	..	..	..	..
63 (61)	..	..	..	..	..
64	0.144765E 09	0.102171E 07	0.924108E 08	0.270054E 07	0.262130E 08
65 (64)	..	..	..	..	..
66 (13)	..	..	..	..	..
67	0.0	0.0	0.0	0.0	0.0
68	0.0	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0
75	0.0	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	0.0	0.0
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	0.0	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	0.0	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	0.0	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	0.0	0.0	0.0
93	0.0	0.0	0.0	0.0	0.0
94	0.0	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0	0.0
96	0.0	0.0	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
TOTALS	0.197426E 11	0.135250E 09	0.119280E 11	0.366732E 09	0.359990E 10

TABLE 1b.
Process pollutants, 1967, based on data from Ref. 2

POUNDS PER ANNUM

SECTOR	PARTICULATES	HYDROCARBONS	SULFUR OXIDE	CARBON MONOXIDE	NITROUS OXIDES
1	0.490000E 10	0.400000E 09	0.600000E 09	0.160000E 11	0.600000E 09
2 (1)	..	..	..	..	..
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.420000E 09	0.0	0.200000E 09	0.0	0.0
14	0.224000E 10	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0
24	0.144000E 10	0.0	0.0	0.166000E 10	0.0
25 (24)	..	..	..	..	..
26	0.0	0.0	0.0	0.0	0.0
27	0.490000E 09	0.150000E 10	0.120000E 10	0.108000E 10	0.334000E 09
28 (27)	..	..	..	..	..
29 (27)	..	..	..	..	..
30 (27)	..	..	..	..	..
31	0.165000E 10	0.760000E 10	0.540000E 10	0.460000E 10	0.660000E 08
32	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0
37	0.438000E 10	0.0	0.0	0.0	0.0
38 (37)	..	..	..	..	..
39	0.434000E 10	0.0	0.780000E 10	0.120000E 11	0.0
40 (39)	..	..	..	..	..
41	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0	0.0
66 (13)	..	..	..	..	..
67	0.0	0.0	0.0	0.0	0.0
68	0.0	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0
75	0.0	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	0.0	0.0
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	0.0	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	0.0	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	0.0	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	0.0	0.0	0.0
93	0.0	0.0	0.0	0.0	0.0
94	0.0	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0	0.0
96	0.0	0.0	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
TOTALS	0.197600E 11	0.960000E 10	0.152000E 11	0.355600E 11	0.100000E 10

TABLE 1c.
Total pollutants, 1967, based on data from Ref. 2

POUNDS PER ANNUM

SECTOR	PARTICULATES	HYDROCARBONS	SULFUR OXIDE	CARBON MONOXIDE	NITROUS OXIDES
1	0.480000E 10	0.400000E 09	0.600000E 09	0.160000E 11	0.600000E 09
2 (1)	..	..	..	..	..
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.591224E 09	0.134488E 07	0.331524E 09	0.332206E 07	0.388573E 08
14	0.416094E 10	0.133700E 08	0.119365E 10	0.357839E 08	0.393169E 08
15	0.824374E 08	0.531917E 06	0.446022E 08	0.149521E 07	0.120476E 08
16	0.622741E 09	0.458390E 07	0.428253E 09	0.118065E 08	0.120852E 09
17 (16)	..	..	..	..	..
18	0.350753E 08	0.315553E 06	0.331962E 08	0.718033E 06	0.995006E 07
19 (18)	..	..	..	..	..
20	0.790029E 08	0.870070E 06	0.101268E 09	0.161911E 07	0.313790E 08
21 (20)	..	..	..	..	..
22	0.102983E 09	0.692639E 06	0.602363E 08	0.185673E 07	0.178102E 08
23 (22)	..	..	..	..	..
24	0.482808E 10	0.230913E 08	0.203026E 10	0.172262E 10	0.589957E 09
25 (24)	..	..	..	..	..
26	0.270999E 08	0.291676E 06	0.337104E 08	0.597522E 06	0.126235E 08
27	0.577761E 10	0.163314E 10	0.390322E 10	0.117528E 10	0.126190E 10
28 (27)	..	..	..	..	..
29 (27)	..	..	..	..	..
30 (27)	..	..	..	..	..
31	0.165000E 10	0.760000E 10	0.540000E 10	0.480000E 10	0.660000E 08
32	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0
34	0.561249E 09	0.372061E 07	0.319245E 09	0.102782E 08	0.909038E 08
35	0.771302E 08	0.580465E 06	0.550560E 06	0.147044E 07	0.153080E 08
36 (35)	..	..	..	..	..
37	0.663130E 10	0.144021E 08	0.120037E 10	0.408551E 08	0.445415E 09
38 (37)	..	..	..	..	..
39	0.734522E 10	0.222147E 08	0.989022E 10	0.120572E 11	0.779827E 09
40 (39)	..	..	..	..	..
41	0.259496E 09	0.227446E 07	0.242455E 09	0.527859E 07	0.871115E 08
42 (41)	..	..	..	..	..
43 (41)	..	..	..	..	..
44 (41)	..	..	..	..	..
45	0.554642E 09	0.469761E 07	0.441146E 09	0.120663E 08	0.136390E 09
46 (45)	..	..	..	..	..
47 (45)	..	..	..	..	..
48 (45)	..	..	..	..	..
49 (45)	..	..	..	..	..
50 (45)	..	..	..	..	..
51 (45)	..	..	..	..	..
52 (45)	..	..	..	..	..
53 (45)	..	..	..	..	..
54 (45)	..	..	..	..	..
55	0.329721E 09	0.246698E 07	0.233108E 09	0.630278E 07	0.733342E 08
56 (55)	..	..	..	..	..
57 (55)	..	..	..	..	..
58 (55)	..	..	..	..	..
59 (55)	..	..	..	..	..
60 (55)	..	..	..	..	..
61	0.841875E 09	0.564410E 07	0.489434E 09	0.154778E 08	0.144710E 09
62 (61)	..	..	..	..	..
63 (61)	..	..	..	..	..
64	0.144765E 09	0.102171E 07	0.924108E 08	0.270054E 07	0.262130E 08
65 (64)	..	..	..	..	..
66 (13)	..	..	..	..	..
67	0.0	0.0	0.0	0.0	0.0
68	0.0	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0
75	0.0	0.0	0.0	0.0	0.0
76	.	.	.	.	.
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	0.0	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	0.0	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	0.0	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	0.0	0.0	0.0
93	0.0	0.0	0.0	0.0	0.0
94	0.0	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0	0.0
96	0.0	0.0	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
TOTALS	0.395026E 11	0.973523E 10	0.271280E 11	0.359067E 11	0.459989E 10

TABLE 2a.

Heat and power generation pollutants, 1967, based on data from Ref. 3

POUNDS PER ANNUM

SECTOR	PARTICULATES	HYDROCARBONS	SULFUR OXIDE	CARBON MONOXIDE	NITROUS OXIDES
1	0.0	0.0	0.0	0.0	0.0
2 (1)	..	..	..	..	..
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0
14	0.100450E 10	0.693221E 09	0.233995E 09	0.215141E 08	0.284731E 08
15	0.503295E 08	0.305420E 08	0.707934E 07	0.700155E 06	0.104761E 07
16	0.264379E 09	0.187694E 09	0.624208E 08	0.608804E 07	0.790244E 07
17 (16)	..	..	..	..	..
18	0.265103E 08	0.275629E 08	0.915072E 07	0.138037E 07	0.155762E 07
19	NA	NA	NA	NA	NA
20	0.317784E 08	0.277151E 08	0.143695E 08	0.120377E 07	0.142631E 07
21 (20)	..	..	..	..	..
22	0.296901E 08	0.180378E 08	0.421137E 07	0.414929E 06	0.619918E 06
23	NA	NA	NA	NA	NA
24	0.195408E 10	0.141046E 10	0.396331E 09	0.470350E 08	0.604314E 08
25 (24)	..	..	..	..	..
26	0.475121E 07	0.937955E 07	0.514242E 07	0.643156E 06	0.674444E 06
27	0.206056E 07	0.156070E 08	0.112634E 08	0.130734E 07	0.131959E 07
28 (27)	..	..	..	..	..
29 (27)	..	..	..	..	..
30 (27)	..	..	..	..	..
31	0.166147E 09	0.173965E 09	0.300294E 09	0.951712E 07	0.109302E 08
32 (31)	..	..	..	..	..
33 (31)	..	..	..	..	..
34	0.231540E 08	0.247285E 08	0.973471E 07	0.126785E 07	0.142412E 07
35	0.426573E 08	0.354932E 08	0.941100E 07	0.143677E 07	0.172501E 07
36 (35)	..	..	..	..	..
37	0.883499E 07	0.196064E 08	0.473824E 08	0.150194E 07	0.160501E 07
38 (37)	..	..	..	..	..
39	0.122685E 09	0.956197E 08	0.431411E 08	0.362255E 07	0.447871E 07
40 (39)	..	..	..	..	..
41	0.892345E 07	0.806561E 07	0.540402E 07	0.366847E 06	0.430737E 06
42 (41)	..	..	..	..	..
43 (41)	..	..	..	..	..
44 (41)	..	..	..	..	..
45	0.486549E 08	0.390358E 08	0.105116E 08	0.151260E 07	0.184268E 07
46 (45)	..	..	..	..	..
47 (45)	..	..	..	..	..
48 (45)	..	..	..	..	..
49 (45)	..	..	..	..	..
50 (45)	..	..	..	..	..
51 (45)	..	..	..	..	..
52 (45)	..	..	..	..	..
53 (45)	..	..	..	..	..
54 (45)	..	..	..	..	..
55	NA	NA	NA	NA	NA
56 (55)	..	..	..	..	..
57 (55)	..	..	..	..	..
58	NA	NA	NA	NA	NA
59 (55)	..	..	..	..	..
60	NA	NA	NA	NA	NA
61	0.422661E 09	0.245558E 09	0.673452E 08	0.495712E 07	0.789682E 07
62 (61)	..	..	..	..	..
63	NA	NA	NA	NA	NA
64	NA	NA	NA	NA	NA
65	NA	NA	NA	NA	NA
66	NA	NA	NA	NA	NA
67	0.0	0.0	0.0	0.0	0.0
68	0.0	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0
75	0.0	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	0.0	0.0
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	0.0	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	0.0	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	0.0	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	0.0	0.0	0.0
93	0.0	0.0	0.0	0.0	0.0
94	0.0	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0	0.0
96	0.0	0.0	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
TOTALS	0.421180E 10	0.306229E 10	0.122724E 10	0.104470E 09	0.133786E 09

TABLE 2b.
Process pollutants, 1967, based on data from Ref. 3

POUNDS PER ANNUM

SECTOR	PARTICULATES	HYDROCARBONS	SULFUR OXIDE	CARBON MONOXIDE	NITROUS OXIDES
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0
14	0.834103E 08	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0
24	0.317709E 10	0.0	0.870534E 08	0.119713E 10	0.0
25	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0
27	0.298891E 08	0.290290E 07	0.315555E 09	0.232447E 09	0.866570E 08
28	0.234908E 09	0.117432E 09	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0
30	0.0	0.162238E 08	0.0	0.0	0.0
31	0.500517E 09	0.582301E 09	0.0	0.647269E 10	0.279809E 10
32 (31)	..	..	..	..	..
33 (31)	..	..	..	..	..
34	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0
37	0.799965E 07	0.0	0.0	0.0	0.550228E 08
38	0.957520E 09	0.0	0.0	0.0	0.756426E 08
39	0.277769E 10	0.0	0.0	0.249806E 10	0.577693E 08
40	0.369061E 09	0.0	0.790C04E 09	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0	0.0
68	0.0	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0
75	0.0	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	0.0	0.0
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	0.0	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	0.0	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	0.0	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	0.0	0.0	0.0
93	0.0	0.0	0.0	0.0	0.0
94	0.0	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0	0.0
96	0.0	0.0	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
TOTALS	0.823808E 10	0.718660E 09	0.119261E 10	0.104003E 11	0.307320E 10

TABLE 2c.
Total pollutants, 1967, based on data from Ref. 3

POUNDS PER ANNUM

SECTOR		PARTICULATES	HYDROCARBONS	SULFUR OXIDE	CARBON MONOXIDE	NITROUS OXIDES
1		0.0	0.0	0.0	0.0	0.0
2	(1)	..	..	..	..	..
3		0.0	0.0	0.0	0.0	0.0
4		0.0	0.0	0.0	0.0	0.0
5		0.0	0.0	0.0	0.0	0.0
6		0.0	0.0	0.0	0.0	0.0
7		0.0	0.0	0.0	0.0	0.0
8		0.0	0.0	0.0	0.0	0.0
9		0.0	0.0	0.0	0.0	0.0
10		0.0	0.0	0.0	0.0	0.0
11		0.0	0.0	0.0	0.0	0.0
12		0.0	0.0	0.0	0.0	0.0
13		0.0	0.0	0.0	0.0	0.0
14		0.1087915 10	0.6932215 09	0.2339955 09	0.2151415 08	0.2847315 08
15		0.5032955 08	0.3054205 08	0.7079345 07	0.7001555 06	0.1047615 07
16		0.2643795 09	0.1E7694E 09	0.5242085 08	0.6038045 07	0.7902445 07
17	(16)	..	..	..	..	..
18		0.2651035 08	0.2756295 08	0.9150725 07	0.1380375 07	0.1557625 07
19		NA	NA	NA	NA	NA
20		0.3177845 08	0.2771515 08	0.1436955 08	0.1203775 07	0.1426315 07
21	(20)	..	..	..	..	..
22		0.2969015 08	0.1803795 08	0.4211075 07	0.4149295 06	0.6199185 06
23		NA	NA	NA	NA	NA
24		0.5131175 10	0.1410465 10	0.4834345 09	0.1244165 10	0.6043145 08
25	(24)	..	..	..	..	..
26		0.4751215 07	0.9379555 07	0.5142425 07	0.6431565 06	0.6744445 06
27		0.2668585 09	0.1521655 09	0.3268235 09	0.2337555 09	0.8797665 08
28	(27)	..	..	..	..	..
29	(27)	..	..	..	..	..
30	(27)	..	..	..	..	..
31		0.7666645 09	0.7562665 09	0.3002945 09	0.6482205 10	0.2809025 10
32	(31)	..	..	..	..	..
33	(31)	..	..	..	..	..
34		0.2315405 08	0.2472855 08	0.9734715 07	0.1267855 07	0.1424125 07
35		0.4265735 08	0.3549325 08	0.9411005 07	0.1436775 07	0.1725015 07
36	(35)	..	..	..	..	..
37		0.9743545 09	0.1960645 08	0.4738245 08	0.1501945 07	0.1322705 09
38	(37)	..	..	..	..	..
39		0.3269445 10	0.9561975 08	0.8331455 09	0.2501595 10	0.6226805 08
40	(39)	..	..	..	..	..
41		0.8923455 07	0.8065615 07	0.5404025 07	0.3668475 06	0.4307375 06
42	(41)	..	..	..	..	..
43	(41)	..	..	..	..	..
44	(41)	..	..	..	..	..
45		0.4865495 08	0.3903585 08	0.1051165 08	0.1512605 07	0.1E42685 07
46	(45)	..	..	..	..	..
47	(45)	..	..	..	..	..
48	(45)	..	..	..	..	..
49	(45)	..	..	..	..	..
50	(45)	..	..	..	..	..
51	(45)	..	..	..	..	..
52	(45)	..	..	..	..	..
53	(45)	..	..	..	..	..
54	(45)	..	..	..	..	..
55		NA	NA	NA	NA	NA
56	(**)	..	..	..	..	..
57	(**)	..	..	..	..	..
58		NA	NA	NA	NA	NA
59	(**)	..	..	..	..	..
60		NA	NA	NA	NA	NA
61		0.4226615 09	0.2455585 09	0.6734525 08	0.4957125 07	0.7896825 07
62	(61)	..	..	..	..	..
63		NA	NA	NA	NA	NA
64		NA	NA	NA	NA	NA
65		NA	NA	NA	NA	NA
66		NA	NA	NA	NA	NA
67		0.0	0.0	0.0	0.0	0.0
68		0.0	0.0	0.0	0.0	0.0
69		0.0	0.0	0.0	0.0	0.0
70		0.0	0.0	0.0	0.0	0.0
71		0.0	0.0	0.0	0.0	0.0
72		0.0	0.0	0.0	0.0	0.0
73		0.0	0.0	0.0	0.0	0.0
74		0.0	0.0	0.0	0.0	0.0
75		0.0	0.0	0.0	0.0	0.0
76		0.0	0.0	0.0	0.0	0.0
77		0.0	0.0	0.0	0.0	0.0
78		0.0	0.0	0.0	0.0	0.0
79		0.0	0.0	0.0	0.0	0.0
80		0.0	0.0	0.0	0.0	0.0
81		0.0	0.0	0.0	0.0	0.0
82		0.0	0.0	0.0	0.0	0.0
83		0.0	0.0	0.0	0.0	0.0
84		0.0	0.0	0.0	0.0	0.0
85		0.0	0.0	0.0	0.0	0.0
86		0.0	0.0	0.0	0.0	0.0
87		0.0	0.0	0.0	0.0	0.0
88		0.0	0.0	0.0	0.0	0.0
89		0.0	0.0	0.0	0.0	0.0
90		0.0	0.0	0.0	0.0	0.0
91		0.0	0.0	0.0	0.0	0.0
92		0.0	0.0	0.0	0.0	0.0
93		0.0	0.0	0.0	0.0	0.0
94		0.0	0.0	0.0	0.0	0.0
95		0.0	0.0	0.0	0.0	0.0
96		0.0	0.0	0.0	0.0	0.0
97		0.0	0.0	0.0	0.0	0.0
TOTALS		0.1244945 11	0.3791155 10	0.2419855 10	0.1050485 11	0.3206995 10

TABLE 3.

The 97-order CAC sectors and their SIC equivalents

CAC #	Sector name	SIC #
1.	Livestock & livestock products	013,014p,0193, 02p,0729p
2.	Other agricultural products	011,012,014p,0192,0199,02p
3.	Forestry & fishery products	074,081,082,084,086,091
4.	Agricultural, forestry,& fishery services	071,0723,0729,085p,098
5.	Iron & ferroalloy ores mining	1011,106
6.	Nonferrous metal ores mining	102,103,104,105,108,109
7.	Coal mining	11, 12
8.	Crude oil & natural gas mining	1311,1321
9.	Stone & clay mining	141,143,144,145,148,149
10.	Chemicals & fertilizer mineral mining	147
11.	New construction	138,15p,16p,17p,6561p
12.	Maintainance & repair construction	15p,16p,17p
13.	Ordance & accessories	19
14.	Food & kindred products	20
15.	Tobacco manufactures	21
16.	Broad & narrow fabrics, yarn & threads	221,222,223,224,226,228
17.	Misc. textile goods & floor coverings	227,229
18.	Apparel	225,23(ex.239),3992
19.	Misc. fabricated textile products	239
20.	Lumber & wood products, exc. containers	24(ex.244)
21.	Wooden containers	244
22.	Household furniture	251
23.	Other furniture & fixtures	25(ex.265)

TABLE 3. (CONT.)

CAC #	Sector Name	SIC #
24.	Paper & allied products, exc. containers	26(ex.265)
25.	Paperboard containers & boxes	265
26.	Printing & publishing	27
27.	Chemicals & selected chemical products	281(ex.2819p),286,287,289
28.	Plastics & synthetics	282
29.	Drugs, cleaning & toilet preparations	283,284
30.	Paints & allied products	285
31.	Petroleum refining & related products	2911,299
32.	Paving mixtures & blocks	2951
33.	Asphalt felts & coatings	2952
34.	Rubber & misc. plastics products	30
35.	Leather tanning & industrial leather	311, 312
36.	Footwear & other leather products	31(ex.311,312)
37.	Glass & glass products	321,322,323
38.	Stone & clay products	324,325,326,327,328,329
39.	Primary iron and steel mfg.	331,332,3391,3399
40.	Primary nonferrous metals mfg.	2819,333,334,335,336,3392
41.	Metal containers	3411,3491
42.	Heating, plumbing, & fabric struct. metal products	343,344
43.	Screw machine products & stamping	345,346
44.	Other fabricated metal products	342,347,348,349(ex.349)
45.	Engines & turbines	351
46.	Farm machinery	352

TABLE 3. (CONT.)

CAC #	Sector Name	SIC #
47.	Construction, mining,& oil field equipment	3531,3532,3533
48.	Materials handling equipment	3534,3535,3536,3537
49.	Metalworking equipment	354
50.	Special industry equipment	355
51.	General industrial equipment	356
52.	Machine shop products	359
53.	Office, computing, & accounting machines	357
54.	Service industry machines	358
55.	Electric transmission/ distribution equipment	361,362
56.	Household appliances	363
57.	Electric lighting & wiring equipment	364
58.	Radio, TV,& communications equipment	365,366
59.	Electronic components & accessories	367
60.	Misc. electrical machinery, equipment, supp.	369
61.	Motor vehicles & equipment	371
62.	Aircraft & parts	372
63.	Other transportation equipment	373,374,375,379
64.	Professional,scientific,& controlling instruments	381,382,384,387
65.	Optical, opthalmic, & photographic equipment	383,385,386
66.	Misc. manufacturing	39(ex.3992)
67.	Railroads & related services	40,474
68.	Local, suburban, & inter-urban hiway transportation	41
69.	Motor freight Trans. & warehousing	42,473

TABLE 3. (CONT.)

CAC #	Sector Name	SIC #
70.	Water transportation	44
71.	Air transportation	45
72.	Pipe line transportation	46
73.	Transportation services	47(ex.473,474)
74.	Communications, exc. radio & TV	481,482,489
75.	Radio & TV broadcasting	483
76.	Electric utilities	491,493p
77.	Gas utilities	492,493p
78.	Water & sanitary services	494,495,496,497,493p
79.	Wholesale & retail trade	50,52,53,54,55,56,57,58,59, 7399p
80.	Finance & insurance	60,61,62,63,64,66,67
81.	Real estate & rental	65(ex.6541,6561p)
82.	Hotels & lodging places; personal services	70,72,76(ex.7694,7699)
83.	Business services	7694,7699,81,89(ex.8921)
84.	Automobile repair & services	75
85.	Amusements	78,79
86.	Medical & educational services	0722,7361,80,82,84,86,8921
87.	Federal government enterprises	---
88.	State & local government enterprises	---
89.	Direct-allocated unoirts	---
90.	Transferred imports	---
91.	Business travel, entertainment & gifts	---
92.	Office supplies	---
93.	Scrap, used & secondhand goods	---

TABLE 3. (CONT.)

CAC #	Sector Name	SIC #
94.	Government industry	---
95.	Rest of world industry	---
96.	Household industry	---
97.	Inventory valuation adjustment	---

TABLE 4.

The RFF sectors and their SIC equivalents

RFF #	Sector Name	SIC #
1-7	Agriculture	01
20-22	Ordnance	19
23-33	Food and kindred products	20
34	Tobacco products	21
35-38	Textile mill products	22
39-40	Apparel and related products	23
41-44	Lumber and wood products	24
45-46	Furniture and fixtures	25
47-51	Paper and allied products	26
52-54	Printing and publishing	27
55-68	Chemicals and allied products	28
69-71	Petroleum and coal products	29
72-74	Rubber and plasticsproducts	30
74-77	Leather and leather products	31
78-82	Stone, clay and glass products	32
83-91	Primary metals	33
92-101	Fabricated metal products	34
102-117	Machinery, except electrical	35
118-131	Electrical machinery	36
132-140	Transportation equipment	37
141-146	Instruments and related products	38
147-150	Miscellaneous manufacturing	39
151	Railroads and subways	40
152	Passenger buses	41p
153	Motor freight transportation	42
154	Vessels	44
155	Aircraft	45
160	Electric utilities	491,4931
163-164	Wholesale and retail trade	50, 52-59
168	Space heating in rental dwellings	65

TABLE 5. Sector output bases, millions 1967 dollars
Source: Ref. [2]

CAC Sector	1963	1967
1	N/A	.74539
2 (1)	"	"
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	.11278	.18475
14	.68466	.87015
15	.4519	.7330
16	.18392	.21695
17 (16)	"	"
18	.17096	.20358
19 (18)	"	"
20	.9200	.12372
21 (20)	"	"
22	.5884	.7437
23 (22)	"	"
24	.16357	.21269
25 (24)	"	"
26	.16165	.19089
27	.31772	.43380
28 (27)	"	"
29 (27)	"	"
30 (27)	"	"
31	.17994	.24700
32 (31)	"	"
33 (31)	"	"
34	.9116	.12746
35	.4290	.4725
36 (35)	"	"
37	.12289	.14013
38 (37)	"	"
39	.35621	.45504
40 (39)	"	"
41	.23065	.32303
42 (41)	"	"
43 (41)	"	"
44 (41)	"	"
45	.30363	.48680

TABLE 5 (cont.)

CAC Sector	1963	1967
46 (45)	..	..
47 (45)	..	..
48 (45)	..	..
49 (45)	..	..
50 (45)	..	..
51 (45)	..	..
52 (45)	..	..
53 (45)	..	..
54 (45)	..	..
55	.29840	.38826
56 (55)	..	..
57 (55)	..	..
58 (55)	..	..
59 (55)	..	..
60 (55)	..	..
61	.55428	.70285
62 (61)	..	..
63 (61)	..	..
64	.6117	.8993
65 (64)	..	..
66 (13)	..	..
67	0	0
68	0	0
69	0	0
70	0	0
71	0	0
72	0	0
73	0	0
74	0	0
75	0	0
76	NA	.19582
77	0	0
78	0	0
79	NA	.144365
80	0	0
81	0	0
82	0	0
83	0	0
84	0	0
85	0	0
86	0	0
87	0	0
88	0	0
89	0	0

TABLE 5. (cont.)

CAC Sector	1963	1967
90	0	0
91	0	0
92	0	0
93	0	0
94	0	0
95	0	0
96	0	0
97	0	0

TABLE 6. The BLS sectors and their SIC equivalents

BLS #	Sector Name	SIC#
	AGRICULTURE, FORESTRY AND FISHERIES	
1	Livestock and livestock products	01
2	Crops and other agriculture products	
3	Forestry and fisheries	074,18,091
4	Agriculture, forestry, and fishery services	071,0723,073pt,0729, 085,098
	MINING	
5	Iron ore mining	101,106
6	Copper ore mining	102
7	Other nonferrous metal ore mining	103-109, except 106
8	Coal mining	11,12
9	Crude petroleum	1311,1321
10	Stone and clay mining and quarrying	142-5,148,149
11	Chemical and fertilizer mining	147
	CONSTRUCTION	
12	New residential construction	
13	New nonresidential construction	
14	New public utilities construction	15,16,17
15	New highway construction	
16	All other new construction	
17	Maintenance construction	
	MANUFACTURING	
18	Guided missile	1925
19	Other ordnance	19 except 1925
20	Food Products	20
21	Tobacco Manufacturing	21
22	Broad and Narrow Fabrics,yarn,& thread mills	221,222,223,224,226, 228
23	Miscellaneous textiles	227,229

TABLE 6. (cont.)

BLS #	Sector Name	SIC #
24	Hosiery and knit goods	225
25	Apparel	23(except 239 & 3992)
26	Miscellaneous fabric textile	239
27	Logging, sawmills and planing mills	241,242
28	Millwork and plywood and miscellaneous wood products	243,244,249
29	Household furniture	251
30	Other furniture	25,except 251
31	Paper products	26, except 265
32	Paperboard	265
33	Printing	271,272,273,274
34	Publishing	275,276,277,278,279
35	Chemical Products	281,286,289
36	Agricultural chemicals	287
37	Plastic materials	2821,2822
38	Synthetic fibers	2823,2824
39	Drugs	283
40	Cleaning and toilet preparations	284
41	Paint	285
42	Petroleum products	29
43	Rubber products	30,except 307
44	Plastic products	307
45	Leather, footwear and leather products	31
46	Glass	321,322,323

TABLE 6. (cont.)

BLS #	Sector Name	SIC #
47	Cement, clay concrete products	324,325,327
48	Miscellaneous stone and clay	326,328,329
49	Blast furnaces and basic steel products	331
50	Iron and steel foundries, forging and miscellaneous products	332,3391,3399
51	Primary copper metals	3331
52	Primary aluminum	3334
53	Other primary nonferrous metal and secondary non-ferrous	3332,3339,334
54	Copper rolling and drawing	3351
55	Aluminum rolling and drawing	3352
56	Other nonferrous rolling and drawing	3356,3357
57	Miscellaneous nonferrous products	336,3392
58	Metal containers	3411,3491
59	Heating apparatus and plumbing	343
60	Fabricated structural metal	344
61	Screw machine products	345,346
62	Other fabricated metal products	342,347,348,349,except 3491
63	Engines and turbines	351
64	Farm Machinery	352
65	Construction, mining and oil field machinery	3531,352,353
66	Material handling equipment	3534,3535,3536,3537
67	Metal working machinery	354
68	Special industry machinery	355
69	General industrial machinery	356

TABLE 6. (cont.)

BLS #	Sector Name	SIC #
70	Machine shop products	359
71	Computers	3573
72	Typewriters and other office machines	357,3xcept 3573
73	Service industry machines	358
74	Electric transmission	361
75	Elecrical industrial	362
76	Household appliances	363
77	Electric lighting and wiring	364
78	Radio and TV receiving sets	365
79	Telephone and telegraph apparatus	3661
80	Radio TV transmitting, signaling, and detection equipment	3662
81	Electronic components	367
82	Miscellaneous electrical machinery	369
83	Motor vehicles	371
84	Aircraft	372
85	Ship and boat building and repair	373
86	Railroad and other miscellaneous transportation equipment	374,375
87	Transportation equipment, NEC	379
88	Professional, scientific and controlling instruments	381,382,387
89	Medical and dental instruments	384
90	Optical and ophthalmic equipment	383,385
91	Photographic equipment and supplies	386
92	Miscellaneous manufactured products	39,except 3992

TABLE 6. (cont.)

BLS #	Sector Name	SIC #
	TRANSPORTATION, COMMUNICATION, AND PUBLIC UTILITIES	
93	Railroad transportation	40,474
94	Local, suburban and interurban highway transportation	41
95	Truck transportation	42,473
96	Water transportation	44
97	Air transportation	45
98	Other trasportation	46,47(except 473 &474)
99	Communications, except radio and TV	48 except 483
100	Radio and TV broadcasting	483
101	Electric utilities	491 & part 493
102	Gas utilities	492 & part 493
103	Water and sanitary services	494,495,496,497 & part 493
	WHOLESALE AND RETAIL TRADE	
104	Wholesale trade	50
105	Retail trade	52,53,54,55,56,57,58, & 59
	FINANCE, INSURANCE AND REAL ESTATE	
106	Finance	60,61,62,67
107	Insurance	63,64
108	Owner occupied dwelling	*
109	Other real estate	65,66
	SERVICES	
110	Hotels and lodging places	70
111	Other personal services	72,76
112	Miscellaneous business services	73 3xcept 731
113	Advertising	731

TABLE 6. (cont.)

BLS #	Sector Name	SIC #
114	Miscellaneous professional services	81,89 except 892
115	Automobile repair	75
116	Motion pictures	78
117	Other amusements	79
118	Doctor,dentist, and other medical services	80(except 806 & 0722)
119	Hospitals	806
120	Educational services	82
121	Nonprofit organizations	84,86,8921
	GOVERNMENT ENTERPRISES	
122	Post office	*
123	Commodity credit corporation	*
124	Other Federal enterprises	*
125	State and Local government enterprises	*
	IMPORTS	
126	Directly allocated imports	*
127	Transferred imports	*
	DUMMY INDUSTRIES	
128	Business travel, entertainment & gifts	*
129	Office Supplies	*
130	Scrap, used and secondhand	*
	SPECIAL INDUSTRIES	
131	Government industry	*
132	Rest of world industry	*
133	Households	*
134	Inventory valuation adjustment	*

TABLE 7. Sectors omitted from RFF report and BLS report

CAC #	Description	Reason
1-2	Agriculture (BLS only)	NEG.
3	Forestry/fishery products	NEG.
4	Ag./for./fish serv.	NEG.
5-10	Mining	N.I.
11-12	Construction	NEG.
67-73	Transportation	N.I.
74-75	Communication	NEG.
76	Electric utilities (BLS only)	N.I.
80	Finance/insurance	NEG.
81	Real estate/rental	NEG.
82-86	Services	NEG.
87-88	State/federal gov't. enterprises	N.I.
89-90	Imports	N.I.
91-93	Dummy industries	N.I.
94	Government industry	N.I.
95	Rest-of-world industry	N.I.
96	Household industry	N.I.
97	Inventory value adjustment	N.I.

NEG: Negligible

N.I.: Not included; insufficient data available

9. REFERENCES

1. U.S. Department of Commerce, Office of Business Economics, Input-Output Structure of the U.S. Economy, 1963, 3 Volumes, U.S. Govt Printing Office, 1969.

2. Ayres, Gutmanis, Shapanka, for International Research and Technology Corporation, Washington, D.C.: Effects of Technological Change On, and Environmental Implications of an Input-Output Analysis for the United States, 1967-2020, IR&T Document #229-R/I, December, 1970.

   2a. Part II, p. II-14, Table #9. (Source listed as Statistical Abstract of the U.S., 1969; First Forecast With the 185-Sector Model, Feb., 1971.)

   2b. Part II, p. III-25, Table #17, and p. III-36, Table #18. (Sources are: 1963 Census of Manufactures, "Fuels and Electric Energy Consumed in Manufacturing Industries: 1962"; and Compilation of Air Pollution Emission Factors, U.S. Public Health Service, 1968.)

   2c. Part II, p. III-27, Table #19. (Source listed as Compilation of Air Pollution Emission Factors.)

3. Memorandum to Jack Alterman, BLS, from Ivars Gutmanis, National Planning Assn., Washington D.C., March 22, 1972, p. 15, Table 7.

4. Coal: 1 ton = 2.54×10^7 btu

   Fuel Oil: 1 bbl. = 6.287×10^6 btu

   Natural Gas: 1 $ft.^3$ = 1.035×10^3 btu

   Distillate Oil: 1 bbl. = 5.825×10^6 btu

   (Standard conversion factors used by CAC Energy Group)

5. Shapanka, Gutmanis, for International Research and Technology Corporation, Washington, D.C.: Economic Costs Associated with Environmental Quality Alternatives in the United States, 1970, 1980, 1985: An Input- Output Analysis, IR&T Document #298-R, September, 1972.

   5a. Table 2.4

   5b. Table 2.5

6. Gutmanis, I. Personal communication, April, 1973

7. U. S. Dept. of Health, Education & Welfare, Nationwide Inventory of Air Pollutant Emissions, 1968. Public Health Service, Environmental Health Service, National Air Pollution Control Administration, #AP-73, Raleigh, N. C., August, 1970. U. S. Government Printing Office, Washington, D. C.

8. Gutmanis, I. Personal communication, February, 1973.

BIBLIOGRAPHIC DATA SHEET	1. Report No. UIUC-CAC-DN-74-126	2.	3. Recipient's Accession No.

4. Title and Subtitle

U.S. AIR POLLUTANT GENERATION IN 1967

5. Report Date: January 8, 1974

6.

7. Author(s): James Toscas

8. Performing Organization Rept. No. CAC 126

9. Performing Organization Name and Address

Center for Advanced Computation
University of Illinois at Urbana-Champaign
Urbana, Illinois 61801

10. Project/Task/Work Unit No.

11. Contract/Grant No. NSF GI-35179X

12. Sponsoring Organization Name and Address

National Science Foundation
1800 G Street
Washington D. C. 20301

13. Type of Report & Period Covered: Research

14.

15. Supplementary Notes

16. Abstracts

In this report, data on 1967 air pollutant generation are assembled from existing data sources, and aggregated to correspond to a 97 sector input-output model under development at the Center for Advanced Computation. Inadequacies and apparent contradictions in existing data are identified and improvements are recommended for making it acceptable for use with the model.

17. Key Words and Document Analysis. 17a. Descriptors

Pollution
Pollutant Generation
Input-Output

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

18. Availability Statement: No restriction on distribution
Available from National Technical Information Service, Springfield, Virginia 22151

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 41

22. Price